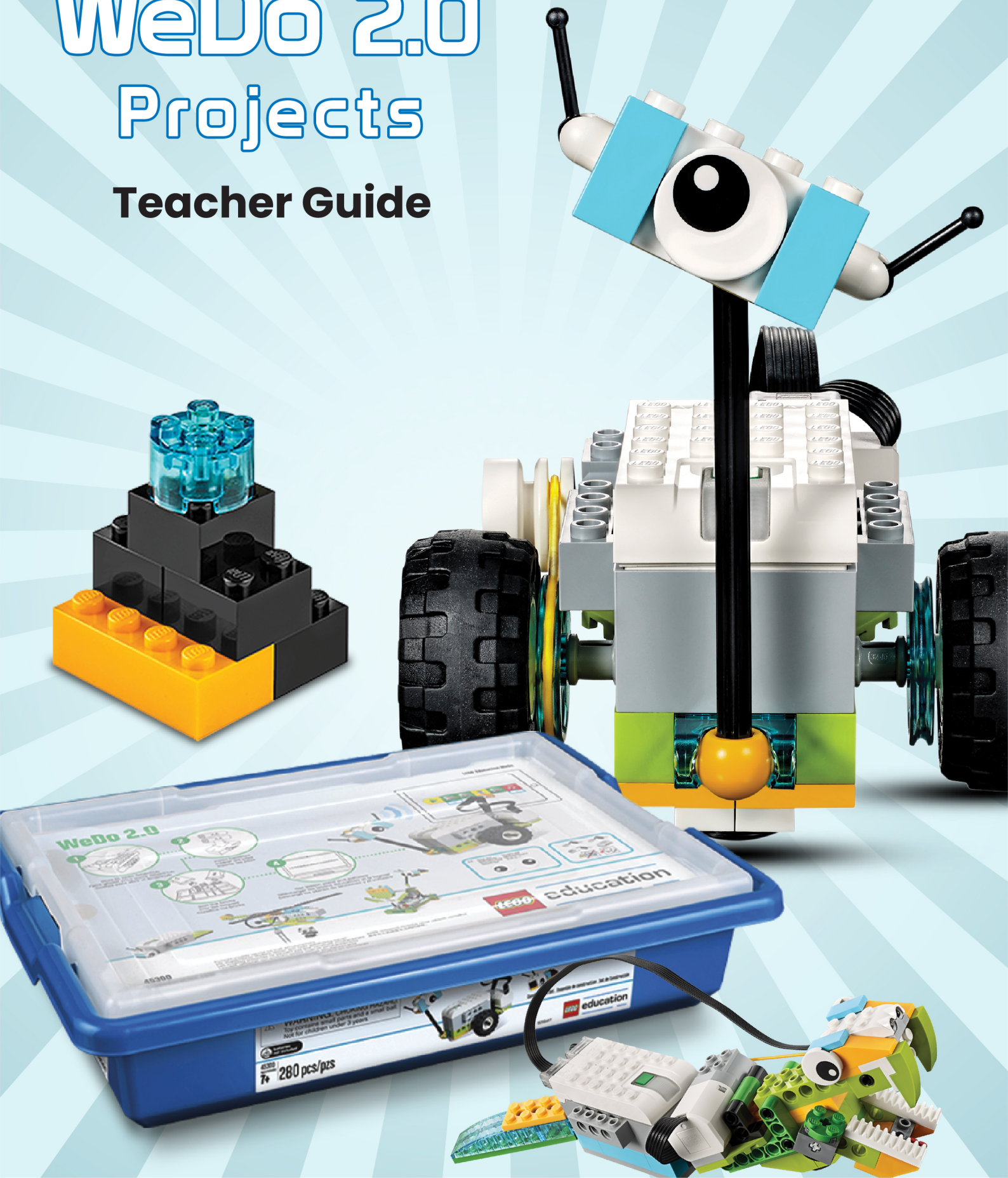
LEGO education

WeDo 2.0 Projects

Teacher Guide



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WEDO 2.0

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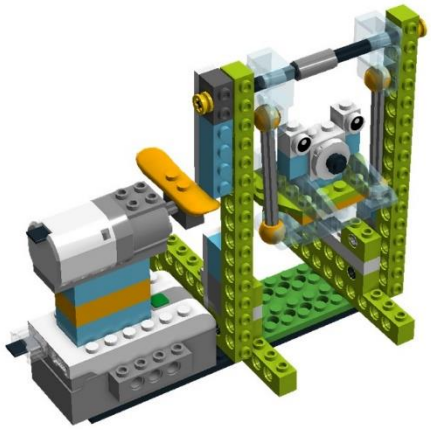
WeDo 2.0 Project



Project at a Glance

In this project Students will explore about swings, pendulum, and how to make the swing goes faster, then create and program a model of a swing.

Key Words:

A playground, a swing, a slide, a seesaw, a pendulum.

Learning Objectives

By the end of this project, students should be able to:

- Describe the swing as a pendulum.
- Identify what makes a swing go faster.
- Give other examples on the pendulum movement.

Introduction

A **pendulum** is a mass (or weight) hanging from a string or rod that swings freely. When you are on a swing you are the mass that is hanging by the swing chains. When you swing back and forth, you become a pendulum!

The factors that affects a pendulum:

1. **The forces of gravity:** The force of gravity pulls the weight, or bob, down as it swings. The pendulum acts like a falling body, moving toward the center of motion at a steady rate and then returning.

2. **The mass of the Pendulum:** One factor that does not affect swing rate is the weight of the bob. Increase the weight on the pendulum and gravity just pulls harder, evening out the extra weight. As School for Champions points out, the force of gravity on any falling object is the same no matter what the object's mass.

3. **Length of the Arm:** The longer the pendulum, whether it is a string, metal rod or wire, the slower the pendulum swings. Conversely the shorter the pendulum the faster the swing rate.

4. **Friction and air Resistance:** In a real-world application air resistance affects the swing rate. Each swing encounters that resistance and it slows down the swing, although it might not be enough to be noticeable during one swing. Friction also slows down the swing. If the pendulum is swinging based upon inertia from the initial release eventually it will come to a stop.

5. **Amplitude**: Amplitude refers to the angle of swing, or how far back the pendulum swings. A resting pendulum has an angle of 0 degrees; pull it back halfway between resting and parallel to the ground and you have a 45-degree angle. Start a pendulum and you determine the amplitude. Experiment with different starting points and you discover that the amplitude does not affect the swing rate. It will take the pendulum the same amount of time to return to its starting point.

One exception involves a very large angle, one beyond any reasonable swing for a clock or any other device. In that case the swing rate will be affected as the pendulum goes faster.

Connection

1) Show your students the connection photo/video of a swing.
2) Ask your students these question for discussion:
   - What can you see in this picture?
   - Have you ever swung on a swing?
   - Do you go faster when you're making big swings or small swings? (Answer: Big swings.)
   - Have you ever observed a pendulum? Which is faster: a pendulum on a long string, or a pendulum on a short string?
   - Can you think of things that move like pendulums?

Some questions that could be asked to the students after you explain the pendulum information above:

1) Explain which factors might affect the period of a pendulum. (Answer: Pendulum length, bob weight, angle pendulum swings through.)

2) Which factor (s) really do affect the pendulum's period? (Answer: The length of the pendulum.)

3) Why does the weight not make a difference? (Answer: Because the pendulum, is like falling objects, is not dependent on weight.)

4) How does the length of a pendulum's string affect its period? (Answer: A pendulum with a longer string has a longer period, meaning it takes a longer time to complete one back and forth cycle when compared with a pendulum with a shorter string. Also, the pendulum with the longer string has a lower frequency, which means it completes less back and forth cycles in a given amount of time as compared with a pendulum with a shorter string.)

5) Why does the angle the pendulum starts at not affect the period? (Answer: Because pendulums that start at a bigger angle have longer to speed up, so they travel faster than pendulums that start at a small angle.)

Create

Hands-On, Minds-ON: (learn by doing)

Students will build a swing using LEGO bricks in the WeDo 2.0 kit, and observe its characteristics. After that, let them program it as suggested and observe how it's functioning.

Share

Ask the students to share, present, and discuss their ideas, models, results of the mission and the engineering based design with the colleagues.

Continue Phase

It's time to take the project to the next level, you can choose a way to enhance the model by changing the code or model structure.

Investigate More

- Ask your students to increase speed of motor in the string. Then predict what happens.
- Ask your students to design their favorite playground. Describe it in their own words.